CHM129.01
Intermolecular Forces

1. Explain the relationship between intermolecular forces and boiling point.

Vaporization requires overcoming intermolecular forces. The stronger the intermolecular forces, greater energy is required for vaporization ⟹ higher boiling point.

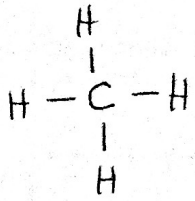
2. Liquid A has a boiling point of 110 °C and liquid B has boiling point of 87 °C. Which liquid has the strongest intermolecular forces?

Liquid A

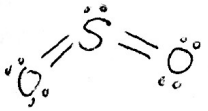
3. Draw the Lewis structure of a molecule of your choosing that contains:
   a. London Dispersion Forces only
   b. Dipole-Dipole Forces
   c. Hydrogen Bonding

Answers will vary

(a)



(b)



(c)

4. What kind of interactions are present in the following: N_2, NH_3, CO, and CCl_4.

N_2 → London Dispersion Forces

NH_3 → London Dispersion Forces
Hydrogen Bonds

CO → London Dispersion Forces
Dipole-Dipole Forces

CCl_4 → London Dispersion Forces

5. For each of the following pair of compounds, pick the one with the highest boiling point. Explain.

a. CH_3OH and CH_3SH Both have LDF & Dipole-Dipole Forces but CH_3OH can form H Bonds. CH_3OH has stronger intermolecular forces.

b. CH_3OCH_3 and CH_3CH_2OH Both have LDF & Dipole-Dipole Forces but CH_3CH_2OH can form H bonds. CH_3CH_2OH has stronger intermolecular forces

c. CH_4 and CH_3CH_3 Both have, LDF but CH_3CH_3 has a larger molar mass (more e^-, more polarizable) so its LDF are stronger.

6. Identify the intermolecular forces present in each of the following and arrange them in order of increasing boiling point: HBr, HF, HI, and HCl.

67°C 20°C -35°C -85°C

HF, HCl, HBr, HI
increasing mass →

HCl < HBr < HI < HF
Boiling Point →

HCl, HBr, HI have same type of intermolecular forces (LDF & Dipole-Dipole). The strength of LDF will depend on their mass (higher mass, stronger LDF). So, boiling point increases as mass increases HCl → HBr → HI. HF has the lowest mass but it can form H bonds (stronger intermolecular force) so it will have the highest boiling point.

7. Which pair of substances would you expect to form homogeneous solutions when combined? What is
* the main force involved?

a. CCl_4 and H_2O Heterogeneous (Immiscible)

b. KCl and H_2O Homogeneous. Ion-Dipole interactions ⇐ main force (strongest IMF).

c. Br_2 and CCl_4 Homogeneous - London Dispersion Forces

d. CH_3CH_2OH and H_2O Homogeneous. Hydrogen bonds ⇐ main force

* Like dissolves like